

# **How to Make Panel Schedules for Sandia Labs**

## **Applicability**

This document describes what files are found on Sandia National Laboratories' Facilities Management & Operations Center's (FMOC) network to support the preparation of standard panel schedules, how those files are to be used, who is the accountable owner of the files, and what your responsibilities are with respect to the panel schedule database.

## **File List and Location**

The panel schedule forms are on Sandia's external web site, <http://www.sandia.gov/engstds/forms.html>. Right-click them to download to your workstation.

The database of completed schedules are kept on FMOC's LONDON network server, and is usually connected to the individual workstation as drive P:\\LONDON\\PANEL. Under that drive are several folders, one of which is the folder PANEL. Inside that folder are additional folders holding panel schedules for each Sandia Technical Area and for the relocatable buildings, plus the following files:

Blank3phase.xls	Schedule template for the usual three-phase panels
Blank3p-subfeed.xls	AS above, with an extra section for a subfeed breaker
Blank1phase.xls	Schedule template for split-phase 120/240 volt panels
Blank2wire.xls	Schedule template for a special one-phase panel (very rarely used)
BlankLoadCenter.xls	Schedule template for a Load Center with molded-case breakers
BlankSwitchboard.xls	Schedule template for Power Switchboards with adjustable-trip breakers
BlankDC.xls	Schedule template for 125volt direct-current substation panels
Blank_I-Line.xls	Schedule template for Square-D I-Line™ three-phase panels
BlankMCC.xls	Schedule template for Motor Control Centers with motor starter data
BlankBusDuct.xls	Schedule template for busways with 3 $\phi$ stab-in breakers and loads
TransformerCalc.xls	Spreadsheet to calculate let-through fault duty, K-factor, and protection
Panel_Instructions.doc	These instructions

## **Workstation Setup**

You must have a browser and ISP to access Sandia's external web, and must have Microsoft Excel 2000™ to load and manipulate the schedules. If you do not have SRN access, you must transmit the finished schedules to someone in the FMOC who does.

To access the database on the SRN, first obtain read/write permission for P:\\LONDON\\PANEL. This is granted by approval of your request through your manager to the Electrical Standards Committee, who then authorizes Facilities Technical Support Services (Dept 10761) to enable your UserID on that drive. Once this is done, you then can attach :\\LONDON\\PANEL to your workstation as a network drive using your file manager. It is suggested you call it drive "P:" for standardization.

## **Using the Panel Schedule Templates**

### **File-Naming Convention**

Each schedule is filed as a single-worksheet Excel workbook and is saved in "Microsoft Excel Workbook" format per the Corporate software standard. The file naming protocol in the past used the eight-character DOS filename limit, with the name being the panelboard's actual name and the extension always .XLS.

Panel “LA” would become LA.XLS, Motor Control Center “D” would become MCC\_D.XLS, and Switchboard “CDP-3” would become SWB\_CDP3.XLS, for examples. The newer software permits filenames longer than eight characters, if needed. Case is not important.

Since there may be more than one schedule with the same name, **file location becomes everything!** Therefore, when giving a new schedule its filename, insure it is placed in the right folder. Panelboard “MAIN” located in building 6581 would thus have the full path of P:\PANEL\AREA5\6581\MAIN.XLS as its location. If you are creating the first panel schedule for a building and it does not have a building folder, create that folder in the proper Technical Area using your file manager and name it with the building's number. Note that schedules for relocatable buildings (MOs and Ts) go in the folder for that type of building, and not in the Technical Area in which the building may be located at that time.

### Passwords

All the files are password-protected and marked as read-only. The password prevents modification of the template's layout and maintains all panel schedules' appearance in a common-look-and-feel as determined by the Specifications and Standards Committee. The read-only attribute also prevents inadvertent overwrite of the template by a new panel being created. When a new schedule is given its name and path, the read-only attribute does not follow the new schedule (but the protection does).

Template protection standardizes the formats of certain cells in the schedule. Revision dates, for instance, will show up as “Mmm-YY” regardless of how you enter them. Font sizes also are fixed, as are cell alignments. At the bottom of each schedule is a statement of when the template was last modified and by whom, plus a date cell indicating when a particular schedule was printed (which is the current date set in the computer doing the printing).

The template protection also makes it easier to enter data. If you use the Tab key instead of the arrow key or mouse to move about the worksheet, the tab will skip all locked cells and land only on those cells in which data should be entered. These cells are buff-colored if you want to navigate by other means. Only the buff-colored cells are unlocked and will accept data.

### “Short” Panel Schedules

The panel schedule templates all have a nominal 42 spaces for breakers, even though many smaller panels at Sandia have fewer than that number. It is customary to X-out spaces not available by using the Excel “Drawing” toolbar to place two long lines along the diagonals of the unusable space. Template protection does not permit the removal or deletion of these rows from the worksheet.

### Two-Section Panels

Two-section panels are laid out the same as single panels, and can be saved as two separate workbooks (A\_SEC1.XLS and A\_SEC2.XLS), or as two worksheets in a single workbook (A.XLS). The main thing to remember is to sum the loads for the subfed section in with the loads for the first section, such that the total loads are shown for the feeder. If section 1 actually has a subfeed breaker or lugs to the second section, just enter or link the second section's loads in the breaker location for the subfeed from the first section. If the two sections are fed by tapping the main lugs on the first section to feed the second, there is no good way to add the loads—you must add the two sections by hand, and enter the total in the schedule of the distribution panel feeding the sections. This latter type (1) is a good candidate for a two-sheet workbook, so that both loads are easily available for the reader, and (2) a design that really should be avoided! (The FMOCC Design Manual forbids these in new construction.)

### Non-Standard Circuit Numbering

Sandia's circuit numbering standard for 3 $\phi$  panelboards is 1,2,3 on the top left, 4,5,6 on the top right, and so on down to 40,41,42 on the bottom right. It is a Design Guide requirement that all new panels follow

this standard. In some places, however, commercial panelboards have been installed with all odd-numbered circuits on the left and even-numbered circuits on the right. For this reason, the circuit number cells on the panelboard templates are unlocked (but not buff-colored). The template opens with the SNL numbering standard, but you can change it to whatever numbering scheme was actually delivered with the panel.

Some existing two-section panels may have the circuits in the second section numbered from 43 to 84. This is no longer a Sandia standard, and each section should start over with circuit #1. The section number, along with the panelboard letter name, becomes part of the panel's full name and distinguishes from which section a given circuit is fed. This also simplifies future work, should the two sections be fed independently at a later date. However, if you must generate a schedule for an older 2-section panel that cannot be renumbered, then just renumber the circuit locations as above.

Finally, some old distribution panels were delivered with a mix of single- and multi-pole breakers, and the multi-pole breakers received a single circuit number instead of 2 or 3 as our standard requires. To as-build one of these, you must erase the SNL numbers for phases A and C, and place the single number opposite phase B. All the other circuit numbers probably must be adjusted as well, as above.

#### Temporary or Work-In-Progress Schedules

You may use the worksheet-copy function under the Edit pulldown menu to make a copy of an existing schedule, then use the copy to make design changes. Use the tab identifiers for each worksheet to identify the original, current version and your proposed, project-related revision. Save the schedule as a workbook with two worksheets. This avoids confusion if there is a long delay between design and construction. Once the work is complete, as-build the copy, delete the original, rename the tab on the remaining worksheet, and save the workbook as the new schedule.

#### How to Create a Multi-Pole Breaker Entry

In the breaker-trip cell for a multiphase breaker, enter the rating only once, in the middle cell. In the other cell (2-pole) or cells (3-pole) place a “\” symbol. This can be a short “Drawing” line, but it is easier to use the backward slash. Do not use *the forward slash* - this activates the pulldown menu, as Excel's default setup mimics the Lotus™ menu convention, and the slash also is an arithmetic operator. If you really want to use the forward slash, precede it with the spacebar.

Each panel template that accommodates both single- and multi-pole breakers has brackets on it that shows the two or three spaces occupied by that breaker belong to a single breaker. To copy or move these brackets, click on the bracket and note it becomes surrounded by six small white boxes. (If the boxes do not appear and the entire cell is highlighted, you missed the bracket's lines.) Hold down the Control key and drag a copy of the bracket to the new location. While still boxed-in, you can fine-tune the bracket's location with the arrow keys. When finished, delete any brackets not used.

#### Working with Older Panel Schedules already on the Server

In a word, try not to. If you find a really old schedule, especially the old green-and-grey templates that don't include any of the above fields, *please* re-create them on the new templates. Save them with the same name, so as to overwrite the old schedule.

Many older schedules used an Excel macro that placed the receptacle and bracket symbols using a small floating toolbar. This macro was written for Excel 4.0 and will not work with Excel 2000 or later. If you open an old schedule with this macro enabled, you may get a macro run-time error window. Here's what to do when that happens:

- Click “End” to stop the macro.

- Pull down the “Tools” toolbar to the “Macro >\Macros...” command, and delete the “AUTO\_OPEN” macro (None of Sandia’s panel templates uses a macro).
- Close the macro windows and re-save the schedule.

This will remove the macro from the panel schedule and avoid the run-time error in the future. Also, if you still have the folder C:\Panel with the files “symbols.xls” and “pnlmacro.xla” in it on your local disk, you may delete it the entire folder.

### **The Square D “I-Line” Panel Schedule**

For a long time, this panel model was banned at Sandia but now has come into gradual use. It has a very unusual trait in that phase selection for a circuit depends not on the breaker’s position in the panel, but on the model number of the breaker and on which side of the panel it resides. It is possible (and has been done!) to fill an I-Line with 42 one-pole A-model breakers and thus place all loads on phase A and none on B or C. Further, a 3-pole breaker will have ABC rotation top-to-bottom when mounted on the left side of an I-Line, but CBA rotation on the right side since it is mounted upside down on that side.

The I-Line schedule template has all the phase cells unlocked, so that a load may be entered in any phase for any breaker position. Also, there is an additional phase identification column in the center of the schedule, since the phase may be different for breakers in opposite sides of the same level. Without the locked-cell protection, it is easy to enter loads for a given circuit in the wrong cell or in more than one cell, which will make the panel load summary incorrect. When designing or as-building these panels, ***you must pay attention to the phase of the I-Line breaker.***

### **The Load Center Schedule**

The Load Center schedule is used for service entrance switchboards where all the breakers are molded-case 3 $\phi$  and where there is a wide variation in the frame size of breakers installed in the panel. The Siemens CDP-series™ is a common example of this at Sandia. This schedule has all three phases available for load input on each row, plus it has two columns for breaker frame letter and trip setting. The circuit numbering column is also unlocked for your use as needed.

When laying out this schedule, note that (usually) breakers of the same size must be located across from each other. You cannot, for instance, locate a K-frame breaker across from an E-frame because the mounting space requirements are different. Be sure you match frame sizes across the schedule. Also, some very large breakers such as LH- or M-frame breakers take up both sets of bus positions in a given row. When scheduling a very large breaker, list the breaker on the side its load conductors are and list “Lug Space for M-frame breaker opposite” on the other side.

To make the schedule look more like an elevation drawing of the panel, you may want to allot more than a single line for the larger frame breakers. If you do, please copy or drag the brackets across the multiple rows, the same as you would do for a multiphase breaker on the smaller panel schedules. However, remember to enter the load currents only in one of the bracketed rows.

### **The Power Switchboard Schedule**

The Switchboard Schedule is useful for distribution switchboards and major service entrances where all the branch circuits are 3 $\phi$  and most or all of the breakers have adjustable trip settings. Reading across the line for an entry, you can edit the slot or bucket location for the breaker, show its type or model, name the circuit, show the frame and trip ratings, enter the load current, record the long, short, and instantaneous pickup and delay settings, and show with an “x” whether a breaker has ground fault protection, is electrically operated, has a Kirk-Key interlock, or has a current-limiting fuse. The last entry is a free-field remarks cell.

If you are laying out a new switchboard, the naming convention is to number the sections from left to right, and letter the breaker buckets from top to bottom. The third breaker down in the leftmost section would thus be numbered 1C. If you have a very large switchboard with more buckets than are available on the template, use the Edit menu to copy the worksheet to a second sheet and continue the layout. Use the bottom-most bucket(s) on the first sheet to import the load amps from the following sheet(s).

### **The Motor Control Center Schedule**

The MCC Schedule provides a quick reference for the loads and equipment options installed in a Motor Control Center. In many cases this information is available on 1-line drawings, but the Schedule provides it in text form on a smaller sheet of paper which can be taped to the face of the MCC. Reading across the line for an entry, you can edit the bucket location for a starter, show both the mechanical unit designator and a text description of its load, enter the motor horsepower and running load amps, enter the circuit's breaker trip rating, the starter's NEMA size number and type, enter digits to show the number of auxiliary contacts on the starter, show with an "x" whether the unit has pilot lights, enter a designator (such as HOA for Hand-Off-Auto) for a mode switch, and show with an "x" whether the bucket has its own control-voltage transformer or uses another source. The last entry is a free-field remarks cell. The Schedule adds the horsepower and RLA columns to display the total MCC load as a balanced 3 $\phi$  current.

If you are laying out a new MCC, the naming convention is to number the columns from left to right, and letter the buckets from top to bottom. The third bucket down in the leftmost column would thus be numbered 1C. Some schedules skip a letter for a double-wide bucket. If you have a very large MCC with more buckets than are available on the template, use the Edit menu to copy the worksheet to a second sheet and continue the layout. Use the bottom-most bucket(s) on the first sheet to import the load amps from the following sheet(s).

All MCC branch circuits are assumed to be balanced 3 $\phi$  loads, so there is only one entry per line. There are a few other conventions for this Schedule: (1) enter horsepower for all motors but enter the RLA for only one motor of a pair when the other is a standby unit, and (2) use the following abbreviations in the starter and switch type cells:

FVNR	Full-Voltage, Non-reversing (most common type)
RVNR	Reduced-Voltage, Non-Reversing (show type in Remarks)
FVR	Full-Voltage, Reversing
VSD or VFD	Variable-Speed Drive or Variable-Frequency Drive (same thing)
2SP	Two-Speed
SS	Solid-State starter
HOA	Hand-Off-Auto
ONOF	On-Off
PB	Pushbutton(s)

### **The Busway or Bus Duct Schedule**

This schedule is used for overhead busways which are fed at one end and have a number of stab-in positions along its length. These are, in effect, 3 $\phi$  Load Centers stretched out in a long line. Reading across the line for an entry, you can edit the stab-in location along the bus, show the stab-in type and its unit designator, enter the circuit's breaker size and trip rating, and enter the load on the stab-in. The last entry is a free-field remarks cell. The stab-in locations are generally numbered from the feeder location, but that cell is unlocked so that other numbering schemes may be used.

### **Using the Transformer Calculator**

You may open this spreadsheet at any time to calculate 3 $\phi$  transformer let-through fault currents as a function of the inverse impedance (which is a quick and acceptable way of calculating approximate fault duties to enter into a schedule). Sandia's standard transformer specification impedances are already entered in a lookup table, so all you need to do is enter the transformer rating and voltages in the buff-colored cells indicated, then read the fault currents in other cells. The Calculator also will provide the NEC minimum protection device ratings and the full-load currents, and will calculate the K-factor if you know the harmonics percentages from Dranetz™ readings on your circuit. The Calculator is marked read-only, so when you are finished simply close it without saving. You may, of course, save a copy with a new name for your project files. It is a design requirement to show both the rated fault withstand and the calculated fault duty on all new panel schedules.

### **Printing a Schedule**

I recommend you simply click the Printer icon on your Excel toolbar. The page setup is already formatted for one page, centered landscape, 8 1/2 x 11 paper, non-color, no header/footer, one copy printing. You may, of course change this as you wish for a given printing, but please do not resave the schedule with the changed page setup. Do not print on a color printer as some of the cells' colors may blank out the data entered in them.

### **An Attempt at Standardization**

#### **Do:**

- Follow the file-naming convention and path described above
- X-out unused spaces in short panels using the Drawing toolbar
- Enter a backslash in multi-pole breaker cells
- Use recognizable abbreviations for manufacturers and model types
- Enter demand load if known, NEC-allowed load if not.
- Calculate and enter the fault duty and withstand rating.
- Watch the phase relationships on I-Line panelboards (*Please!*)
- At the bottom of the schedule, delete the conductor colors not used
- Put revision letters in the Revision Level box and at the affected circuit's margin
- Tell what a circuit does, and where it is (if known – try to find out)
- Use uppercase throughout (Caps Lock)

#### **Don't:**

- Delete, rename, move, or mess with the templates in P:\PANEL
- Enter load currents for spare breakers or spaces
- Leave a Circuit Description empty – at least enter the word "SPACE" or "SPARE"
- Copy stuff from old schedules with outdated templates—NO! NO! **BAD!**

### **Template Ownership**

This file and the templates listed herein are maintained by Gary L. Hoe, PE, Sandia Department 10864, MS-0945, (505)844-3710, glhoe@sandia.gov. Please contact him with any questions about these templates or how to use them.